Capital accumulation, technical progress and wage flexibility: Keynes´ approach to aggregate supply and demand analysis revisited

By

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Abstract: The aggregate supply and demand model (AS-AD) posited by Keynes in the *General Theory* and elaborated by Weintraub and Davidson is analysed by inserting a CES production function. We perform a comparative statics analysis where the effects on the equilibrium level of employment and the price level of changes in a wide range of variables and parameters are worked out. The effect of changes in the money wage rate on the level of employment and the price level are found to be ambiguous. Finally, we argue that this approach provides a more consistent approach than conventional AS-AD analysis does.

Key words: aggregate supply and demand analysis, involuntary employment, technical progress, capital accumulation and deflation

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1.- Introduction

Conventional aggregate supply-aggregate demand (AS-AD) analysis - depicting the economy in a diagram with an upward sloping aggregate supply curve and a downward-sloping aggregate demand curve in price level-real output space - has recently emerged as the preferred framework for teaching macroeconomics at the undergraduate level since it plays a central role in almost all principles and intermediate macroeconomics textbooks. Nevertheless, it has been attacked for 'failing to adequately depict the operation of economies (and perverting the true message of the Keynesian revolution), and for oversimplifying and leading to a conflation of macroeconomics and microeconomic concepts' (Dutt, 2002, p.322). As a result, a growing chorus of scholars recommends its suppression as a teaching device (see, for instance, Barro, 1994 and Colander, 1995). By contrast, the AS-AD framework posited by Keynes (1936, ch.3) in the *General Theory* and elaborated mainly by Weintraub and Davidson does not possess the weaknesses and inconsistencies attributed to conventional AS-AD analysis[1] but, paradoxically, it has almost disappeared from scholarly journals and macroeconomic texts (Dutt, 2002, pp. 328-330). The purpose if this paper is to revisit Keynes´ AS-AD framework to analyse the effects on the level of employment of changes in a range of variables, the main focus being the effects of capital accumulation, technical change and variations on the money wage rate. To do so, we build on the AS-AD model elaborated by Weintraub and Davidson. In particular, we insert a constant elasticity of substitution (CES) production function and solve a system of simultaneous linear equations in order to perform a comparative statics analysis. We show results regarding the effect on the equilibrium level of employment, the price level and the real wage of changes in a range of variables and parameters. We find that the effects of cuts in the money wage rate on the equilibrium level of employment and the price level are ambiguous, especially when

due account is taken of the effect on the debt burden of firms of changes in the price level. The content of the paper is as follows. Section 2 briefly introduces the AS-AD model developed by Weintraub and Davidson. We display the 'basic' AS-AD model in section 3. The aggregate supply and aggregate demand functions are set out and their properties analysed. In turn, this is followed by a full comparative statics analysis where we explicitly set the level of employment and the price level as the endogenous variables. Section 4 contains the 'extended' AS-AD model. Unlike the former, the latter takes due account of the effect on investment of changes in the debt service of firms expressed in real terms. This is one of the factors that Keynes (1936, ch.19) identified as making wage flexibility undesirable for macroeconomic stability. The 'extended' AS-AD model leads to different results regarding the effect of cuts in the money wage rate on the level of employment. Section 5 concludes.

2.- Keynes´ approach to AS-AD analysis

This section introduces what we call Keynes´ approach to AS-AD analysis. Though this approach was posited in chapter 3 of the *General Theory* (Keynes, 1936), it was actually developed[2] in Weintraub (1956, 1957, 1958) and elaborated in Davidson (1962, 1967, 1972), Davidson and Smolensky (1964) and Chick (1983). We start off with the aggregate supply function $Z(N)$. Firms produce in order to maximise expected profit and 'it is in the nature of the business of producing for sale on the market that the choice of what and how much to produce, and how to price things, must be made on the basis of estimates of costs and a forecast of demand' (Chick, 1983, p. 62). This is the central fact on which the aggregate supply curve is based. Profits are reckoned in money terms: revenue (or sales) minus costs. In a market economy, these decisions must be made in advance of actual sales because production takes time. As a result, there will be

some quantity of workers that each firm will seek to hire for each level of expected sales. In the aggregate, therefore, there will be a systematic relationship between the number of workers (*N*) that firms want to hire and the expected total volume of sales (*Z*). This relationship is called the *aggregate supply curve* and is drawn as the Z-curve in figure 1 below. It is upward sloping because the more firms expect to sell, the larger the number of workers firms will want to hire[3]. Its shape depends upon the costs of production, the degree of market power and the composition of output (Vickers, 1987, p. 91). If we assume that the degree of market power is constant and that the composition of output and demand does not change with the overall volume of output[4], then its shape will be determined only by technological factors.

Hiring decisions based on firms´ expectations of sales give rise, in turn, to a flow of money payments to the owners of productive factors. For instance, there will be a flow of money-wage payments to workers, a flow of interest payments to rentiers and a flow of money payments to profit recipients. These money income flows provide the funds with which households can purchase the goods and services produced by firms. The greater the level of employment is, the greater will be the flow of income payments to households and total spending on consumption goods. However, the government, foreigners and firms themselves also purchase the products of the industry so that, at any level of employment, the sum of expenditures by all these sectors on goods and services produced domestically is called aggregate demand. Since, as employment increases, the money payments to households as well as the profits accruing to firms also rise, we may assume that, in general, total spending grows as employment expands. As a result, the *aggregate demand function* is upward sloping as indicated by the D-curve in figure 1 below.

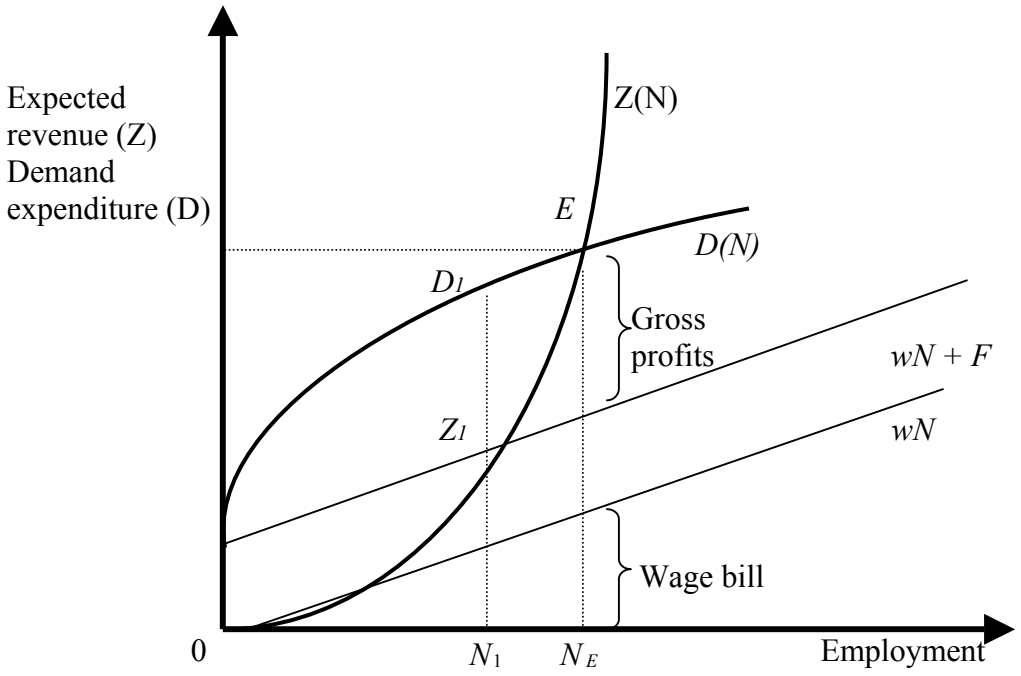

Figure 1: The aggregate supply and demand curves

Given the aggregate supply and demand curves, it is possible to determine the equilibrium level of employment and revenue. The equilibrium position in figure 1 above is *stable* since the intercept of the aggregate demand function is positive[5] and the slope of the latter is lower than the slope of the aggregate supply function in the neighbourhood of their intersection (Chick, 1983, p.64). Suppose firms expect sales of Z_1. Thus, firms will hire N_1 workers. However, if N_1 workers are hired, aggregate demand will be D_1, which exceeds firms´ sales expectations. As a result, there is an incentive to firms to increase employment up to the value of *N* for which *Z* is equal to *D*, i.e. up to N_E in figure 1, so that

'The volume of employment is given by the point of intersection between the aggregate demand function and the aggregate supply function; for it is at this point that the entrepreneurs´ expectation of profits will be maximised. The value of D at the point

of the aggregate demand function, where it is intersected by the aggregate supply function, will be called *the effective demand*' (Keynes, 1936, p.25).

Similarly, if we start from a level of employment to the right of the intersection of the aggregate supply and aggregate demand functions, then firms´ expectations are disappointed as they find that actual aggregate demand falls short of expected sales. The disappointment induces them to cut back on employment and this process continues until the economy reaches N_E (see Davidson and Smolensky, 1964, p.145). Therefore, the point of *effective demand* represents an equilibrium level of spending where firms´ expectations are just being fulfilled so that there is no further inducement to vary the amount of employment[6]. At any level of employment the profit share on gross national income or, alternatively, the difference between total revenue and total variable costs for all firms in the economy, is determined by the position of the aggregate supply function relative to the wage bill line. The latter is a *linear* ray from the origin whose slope is the money wage rate. Further, since aggregate gross profits are obtained by subtracting total costs from aggregate total revenue at each level of employment and total costs for fully integrated firms are the sum of wage payments (wN) plus total fixed costs (F), we have that the vertical difference between the aggregate supply function $Z(N)$ and the $wN + F$ line represents aggregate gross profits. At employment levels above N_1 firms are, on average, making profits and employment levels below N_1 are only temporary and can thus be discarded for, in that range, firms go bankrupt (Weintraub, 1957, p. 459).

3.- The 'basic' AS-AD model

In this section we describe the 'basic' AS-AD model. It is to be contrasted to the 'extended' AS-AD model presented in section 4 below. Unlike the 'basic' AS-AD

model, the 'extended' AS-AD model takes into consideration the effect on investment of changes in the ratio of firms´ debt service to nominal aggregate output. First, we address the derivation of the aggregate supply curve. Second, we derive the aggregate demand curve. Finally, we show results and discuss the policy implications of the comparative statics analysis.

3.1.- The aggregate supply function

This subsection describes the supply side of the economy and the derivation of the aggregate supply function. This supply relation was originally posited in Keynes´ *General Theory* (Keynes, 1936, pp. 24-25). The economy consists of a large number *n* of identical and fully integrated firms using equal amounts of physical capital and similar technology. The output in firm *i* is equal to

$$y_i = \Omega_i^{1/\rho} = \left(\alpha \left(\Lambda_N N_i\right)^{\rho} + (1-\alpha)\left(\Lambda_K K_i\right)^{\rho}\right)^{/\rho} \qquad \rho \prec 0 \qquad (1)$$

where N_i is employment, K_i is physical capital and Λ_N and Λ_K are indices of productive efficiency. Labour-augmenting and capital-augmenting technical progress are indicated by an increase in Λ_N and Λ_K respectively. As a result, technical progress has a labour-augmenting bias if Λ_N increases faster than Λ_K, and a capital-augmenting bias if the reverse is the case. The elasticity of substitution between labour and capital is denoted by σ. Following results for it reported in Rowthorn (1999), let us assume that $\sigma \prec 1$ or, equivalently, that $\rho \prec 0$ where $\sigma = 1/(1-\rho)$. The marginal product of labour M_i and the average product of labour A_i for firm *i* are equal to

$$\frac{\partial y_i}{\partial N_i} = M_i = \alpha \Lambda_N^{\rho} N_i^{\rho - 1} \Omega_i^{1/\rho - 1} \succ 0 \qquad (2)$$

$$\frac{y_i}{N_i} = A_i = \frac{1}{N_i} \cdot \Omega_i^{1/\rho} \tag{3}$$

The ratio of the average to the marginal product of labour for firm *i* is equal to

$$\frac{A_i}{M_i} = 1 + \left(\frac{1-\alpha}{\alpha}\right) \cdot \left(\frac{\Lambda_K K_i}{\Lambda_N N_i}\right)^{\rho} \tag{4}$$

so it converges to a constant as $\rho \to 0$.

Each profit-maximising firm sets the price according to the expression

$$p_i = m_i \cdot \left(\frac{w}{M_i}\right) \tag{5}$$

where

$$m_i = \left(\frac{1}{1 - 1/\varepsilon_i^d}\right) \geq 1 \tag{6}$$

and *w* is the economy-wide money wage rate, p_i is the price of output of firm *i*, ε_i^d is the price-elasticity of demand faced by firm *i* and m_i is one plus the mark-up set by firm *i* and represents its degree of monopoly. Let us assume that m_i is constant. It will be equal to unity under perfect competition but higher than unity otherwise. If the absence of the subscript *i* denotes an economy-wide variable, then the relative wage share *WS* is

$$WS = \left(1 - \frac{1}{\varepsilon_d}\right) \cdot \left(\frac{M}{A}\right) \tag{7}$$

the natural rate of growth of the economy g_n is

$$g_n = l + \lambda_N - \lambda_K \tag{8}$$

the general price level *p* is[7]

$$p = m \cdot \left(\frac{w}{M}\right) \tag{9}$$

and the aggregate supply function $Z(N)$ is

$$Z(N) = py = \left(\frac{A}{M}\right) \cdot mwN \tag{10}$$

or $$Z(N) = mwN + \left(\frac{1-\alpha}{\alpha}\right) mw\, \Lambda_K^{\rho} K^{\rho} \Lambda_N^{-\rho} N^{1-\rho} \tag{11}$$

It emerges from (11) that, with a Cobb-Douglas production function ($\rho \to 0$), the aggregate supply function is represented by the projection of a *linear* ray from the origin (Vickers, 1987, p. 92). It must be noted that the assumption that all firms are fully integrated implies that aggregate total revenue is equal to the value of aggregate gross output, i.e., the gross national product (GNP) of the economy, which is also equal to the aggregate gross money income of the economy. 'Thus, the aggregate supply function relates expected levels of GNP to employment' (Davidson and Smolensky, 1964, p. 123). The partial derivatives of the $Z(N)$ function with respect to N, K, Λ_K, Λ_N and w are

$$\frac{\partial Z(N)}{\partial N} = pM \cdot \left[1 + (1-\rho)\left(\frac{1-\alpha}{\alpha}\right)\Lambda_K^{\rho} K^{\rho} \Lambda_N^{-\rho} N^{-\rho}\right] \succ 0 \tag{12}$$

$$\frac{\partial Z(N)}{\partial K} = \rho mw \left(\frac{1-\alpha}{\alpha}\right) \Lambda_K^{\rho} K^{\rho-1} \Lambda_N^{-\rho} N^{1-\rho} \prec 0 \tag{13}$$

$$\frac{\partial Z(N)}{\partial \Lambda_K} = \rho mw \left(\frac{1-\alpha}{\alpha}\right) \Lambda_K^{\rho-1} K^{\rho} \Lambda_N^{-\rho} N^{1-\rho} \prec 0 \tag{14}$$

$$\frac{\partial Z(N)}{\partial \Lambda_N} = -\rho mw \left(\frac{1-\alpha}{\alpha}\right) \Lambda_K^{\rho} K^{\rho} \Lambda_N^{-\rho-1} N^{1-\rho} \succ 0 \tag{15}$$

$$\frac{\partial Z(N)}{\partial w} = mN + m\left(\frac{1-\alpha}{\alpha}\right) \Lambda_K^{\rho} K^{\rho} \Lambda_N^{-\rho} N^{1-\rho} \succ 0 \tag{16}$$

and the employment-elasticity of aggregate supply ε_{ZN} is

$$\varepsilon_{ZN} = \frac{\partial N}{\partial Z} \cdot \frac{Z}{N} = \frac{1 + \left(\frac{1-\alpha}{\alpha} \right) \cdot \Lambda_K^{\rho} K^{\rho} \Lambda_N^{-\rho} N^{-\rho}}{1 + (1-\rho)\left(\frac{1-\alpha}{\alpha} \right) \cdot \Lambda_K^{\rho} K^{\rho} \Lambda_N^{-\rho} N^{-\rho}} \prec 1 \qquad (17)$$

Expression (12) shows that $Z(N)$ slopes upward in expected nominal aggregate revenue-employment space. Expressions (13), (14), (15) and (16) tell us respectively that an increase in K or Λ_K shifts the $Z(N)$ function outward whereas a rise in Λ_N or w shifts it inward. These formal results roughly confirm the predictions that emerged from the verbal discussion in Weintraub (1958, pp. 80-85). Finally, expression (17) tells us that a 1 per cent rise in expected revenue fosters a rise in employment of less than 1 per cent so that the aggregate supply function is *convex* as long as $\rho \prec 0$ (Weintraub, 1957, p. 459; Vickers, 1987, p. 94). However, if the technology available to firms is of the Cobb-Douglas type $(\rho = 0)$, then $\varepsilon_{ZN} = 1$ and, as argued above, the aggregate supply function becomes the projection of a *linear* ray from the origin[8].

3.2.- The aggregate demand function

A detailed exposition of the derivation of the aggregate demand function *D(N)* can be found in Weintraub (1958, ch.2), Davidson and Smolensky (1964, ch. 10) and Chick (1983, ch. 6). Our presentation relies heavily on the first two contributions. As argued above, at each level of employment there is a flow of money payments from firms to households. These payments, which are the incomes of individuals, the propensities to consume of the different income groups, and the price level, determine the consumption outlays of the household sector. Let us identify three different income groups: wage earners, rentiers and profit recipients[9]. First, at any level of employment there is a flow of money-wage payments (wN) to workers. Second, most firms have outstanding debts as a consequence of having borrowed in the past. The resulting

payments (F) to the holders of the debt contracts are the fixed costs of the firms. The ultimate holders of the debt contracts are called rentiers. Let us assume that firms are net debtors and the household sector is a net creditor[10]. This assumption is realistic for most economies. Finally, if we subtract total costs from total revenue at each level of employment we obtain aggregate gross profits R . For fully integrated firms, total costs are simply wage payments plus fixed costs. Thus, total nominal disposable income Y_d is equal to

$$Y_d = wN + kR + F \tag{18}$$

and aggregate gross profits are

$$R = py - wN - F \tag{19}$$

where k is the proportion of gross profits not retained by firms or, equivalently, the proportion of gross profits that is regularly disbursed as income to profit recipients. Aggregate consumption in nominal terms is

$$C(Y_d) = c_w \cdot wN + c_d\left(k \cdot (py - wN - F)\right) + c_r F \tag{20}$$

where c_w is the propensity to consume by wage earners, c_d is the propensity to consume by profit recipients and c_r is the propensity to consume by rentiers. Re-arranging terms, we get

$$C(Y_d) = c_w \cdot wN + c_p\left(py - wN\right) + \left(c_r - c_p\right) \cdot F \tag{21}$$

where $c_p = c_d \cdot k \succ 0$ and $\left(c_r - c_p\right) \cdot F$ is a component – along with the nominal flow of investment - of the intercept on the vertical axis of the aggregate demand function. The level of investment in nominal terms is

$$I = p \cdot \Delta K = I\big((1-k)R; r; \psi\big) \tag{22}$$

where $(1-k)\cdot R$ is retained gross profits, r is a measure of the cost of capital and ψ is the expected profitability of investment. The introduction of Ψ in (22) recognizes the possibility, as Keynes (1936) certainly does, that long-period profit expectations may shift independently of strictly economic results like, for instance, gross profits. Lastly, $I_{gp} \succ 0$ is the propensity to invest out of gross profits whereas $I_p = (1-k)\cdot I_{gp} \succ 0$ is the propensity to invest out of retained profits[11]. The aggregate demand function $D(N)$ is obtained by adding aggregate total consumption by households and investment by firms

$$D(N) = c_w wN + c_p\big(py - wN\big) + \big(c_r - c_p\big)\cdot F + I((1-k)R; r; \psi) \tag{23}$$

The partial derivatives with respect to N, K, Λ_K, Λ_N and w are

$$\frac{\partial D(N)}{\partial N} = pM\left[\big(c_w - c_p - I_p\big)\frac{1}{m} + \big(c_p + I_p\big)\right] \succ 0 \tag{24}$$

since $c_p + I_p \prec 1$ and $c_w \prec 1$.

$$\frac{\partial D(N)}{\partial K} = p(1-\alpha)(c_p + I_p)\,\Lambda_K^{\rho}\,K^{\rho-1}\Omega^{1/\rho-1} \succ 0 \tag{25}$$

$$\frac{\partial D(N)}{\partial \Lambda_K} = p(1-\alpha)(c_p + I_p)\,\Lambda_K^{\rho-1}\,K^{\rho}\,\Omega^{1/\rho-1} \succ 0 \tag{26}$$

$$\frac{\partial D(N)}{\partial \Lambda_N} = p\alpha(c_p + I_p)\,\Lambda_N^{\rho-1}\,N^{\rho}\,\Omega^{1/\rho-1} \succ 0 \tag{27}$$

and

$$\frac{\partial D(N)}{\partial w} = (c_w - c_p - I_p)\cdot N \begin{matrix}\leq \\ \geq\end{matrix} 0 \tag{28}$$

Expression (24) confirms that the aggregate demand curve $D(N)$ slopes upward in total revenue-employment space. Expressions (25), (26) and (27) tell us that an increase in K, Λ_K, Λ_N shifts the $D(N)$ curve upward thereby raising the equilibrium level of employment and the level of effective demand other things constant. This is because a rise in any of these variables raises gross profits and this, in turn, raises consumption and investment demand. Lastly, expression (28) indicates that the effect of a change in the money wage rate on the aggregate demand curve is ambiguous and depends on the relative value of the propensity to consume by wage earners and profit recipients as well as the propensity to invest out of retained profits.

Finally, we address the important issue of the stability of the equilibrium of the model. A determinate and stable equilibrium is a necessary condition to perform the comparative statics analysis. As shown in figure 1 above, the point of effective demand is determinate and stable if the $D(N)$ curve cuts the $Z(N)$ curve from above (Weintraub, 1957, p. 466; Davidson and Smolensky, 1964, p.146; Chick, 1983, p.70). In turn, this is the case if the $D(N)$ curve has a positive intercept *and* its slope is lower than the slope of the $Z(N)$ curve at the intersection point. Thus, the stability condition is:

$$\left(c_r - k \cdot c_d\right) \cdot F + I \succ 0 \tag{29}$$

$$\frac{dD(N)/dN}{dZ(N)/dN} = \frac{(c_w - c_p - I_p)(1/m) + (c_p + I_p)}{1 + (1-\rho)\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho}} \prec 1 \tag{30}$$

It is clear that condition (30) is fulfilled. As for condition (29), let us assume that it is also fulfilled. Thus, we can move on to the comparative statics analysis.

3.3.- Comparative statics analysis in the 'basic' AS-AD model

The comparative statics analysis below assumes implicitly that individual short-period expectations are always realised so that the system moves *instantly* to the point of effective demand *E* in figure 1 above. Thus, the model resembles what Kregel (1976) calls the 'Model of Static Equilibrium' suggested by Keynes in his 1937 Lectures. In order to perform the comparative statics analysis we set up the *E* and *PL* equations as

$$E = D(N) - Z(N) \qquad \text{or} \qquad (31)$$

$$E = c_w wN + c_p R + (c_r - c_p)F + I((1-k)R; r; \psi) - mwN - \left(\frac{1-\alpha}{\alpha}\right) mwN \left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho} \qquad (32)$$

and

$$PL = p - \left(\frac{mw}{\alpha}\right) \Lambda_N^{-\rho} N^{1-\rho} \cdot \Omega^{1-1/\rho} \qquad (33)$$

We choose the price level p and the level of employment N as the endogenous (or basic) variables and the remaining variables are deemed exogenous (or non-basic). By applying the theorem of existence of implicitly expressed vector fields (see appendix for details) and performing some algebraic transformations, we get the following results

$$\frac{dN}{dK} = \left(\frac{1}{BM}\right) \cdot \left(\Lambda_K K\right)^{\rho} K^{-1} (1-\alpha)\rho \cdot (1 - c_p - I_p) \succ 0 \qquad (34)$$

since $c_p + I_p \prec 1$, $\rho \prec 0$, $M \succ 0$, and $B \prec 0$ where

$$B = \left[(c_w - c_p - I_p)(1/m) + (c_p + I_p - 1) \cdot \left(1 + (1-\rho)\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho} \right) \right] \prec 0.$$

$$\frac{dN}{dw} = \left(\frac{1}{BM}\right) \cdot (N/pl) \cdot \left[(-c_w + c_p + I_p) + m(1 - c_p - I_p) \cdot \left(1 + \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho} \right) \right] \prec 0 \qquad (35)$$

since $c_w \prec 1$

$$\frac{dN}{dm} = \left(\frac{1}{BM}\right) \cdot (1/m) \cdot \Omega^{1/\rho} \cdot (1 - c_p - I_p) \prec 0 \tag{36}$$

$$\frac{dN}{d\,\Lambda_K} = \left(\frac{1}{B}\right) \cdot \left(\frac{1-\alpha}{\alpha}\right) \cdot \left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho} N \cdot \rho \cdot \Lambda_K^{-1} \cdot (1 - c_p - I_p) \succ 0 \tag{37}$$

$$\frac{dN}{d\,\Lambda_N} = \left(\frac{1}{BM}\right) \cdot \Lambda_N^{-1} \cdot \Omega^{1/\rho} \cdot \rho \cdot \frac{(1-\alpha)\left[\Lambda_K K\right]^{\rho}}{\Omega} \cdot \left(c_p + I_p - 1)\right) \prec 0 \tag{38}$$

$$\frac{dN}{d\,c_w} = \left(\frac{-1}{B}\right) \cdot \frac{N}{m} \succ 0 \tag{39}$$

$$\frac{dN}{d\,c_d} = \left(\frac{-1}{BM}\right) \cdot k \cdot \left(y - \frac{MN}{m} - \frac{F}{p}\right) \succ 0 \tag{40}$$

since aggregate gross profits in real terms $= \left(y - \frac{MN}{m} - \frac{F}{p}\right) \succ 0$.

$$\frac{dN}{dF} = \left(\frac{1}{BM}\right) \cdot (1/pl) \cdot \left(-c_r + c_p + I_p\right) \underset{\geq}{\leq} 0 \tag{41}$$

since $T_1 = -c_r + c_p + I_p \underset{\geq}{\leq} 0$

$$\frac{dN}{dk} = \left(\frac{1}{BM}\right) \cdot (I_{gp} - c_d) \cdot \left(y - \frac{MN}{m} - \frac{F}{p}\right) \underset{\geq}{\leq} 0 \quad \text{since} \quad T_2 = I_{gp} - c_r \underset{\leq}{\geq} 0 \tag{42}$$

$$\frac{dN}{dr} = \left(\frac{-1}{BM}\right) \cdot (1/p) \cdot I_r \prec 0 \quad \text{since} \quad I_r \prec 0 \tag{43}$$

$$\frac{dN}{d\psi} = \left(\frac{-1}{BM}\right) \cdot (1/p) \cdot I_\psi \succ 0 \quad \text{since} \quad I_\psi \succ 0 \tag{44}$$

These results are summarized in table 1 below. As for the effect of an increase in physical capital K (expression 34), we know from (13) that the aggregate supply curve shifts outward and we know from (25) that the aggregate demand curve shifts upward so the final equilibrium level of employment N_E must necessarily be located at the

right of the initial one. Therefore, whenever the net rate of investment in real terms is positive N_E will keep on rising. Expression (35) tells us that a rise (fall) in the money wage rate w reduces (raises) N_E. Notwithstanding the caveats to this outcome made in sections 3.4 and 4 below, this is an important result. As shown in (16), a rise in w shifts the aggregate supply curve inward whereas, as indicated in (28), the net effect on the aggregate demand curve is ambiguous. However, expression (35) shows unambiguously that, no matter what the effect on the aggregate demand curve is, a rise (fall) in w reduces (raises) N_E in the 'basic' AS-AD model. This suggests that, given enough time to let all the adjustments work themselves out wage flexibility will drive the economy to its full employment equilibrium. It also suggests that, unless there is wage rigidity, the long-run level of economic activity is supply-side determined. Needless to say, this result is in conformity with Classical theory[12]. We return to this point below.

Expression (36) indicates that a rise in the average degree of monopoly reduces N_E. This is because a rise in m shifts the aggregate supply and demand curves inward and upward respectively, but the former effect is stronger than the latter. Expression (37) indicates that capital-augmenting technical progress has a positive effect on N_E. On the one hand, as shown in (26), a rise in Λ_K increases gross profits thereby shifting the aggregate demand curve upward. On the other hand, as reflected in (14), the rise in Λ_K shifts the aggregate supply curve outward. Unlike capital-augmenting technical progress, expression (38) posits that labour-augmenting technical progress has a negative impact on N_E. As expression (27) reflects, a rise in Λ_N increases the volume of profits thereby raising aggregate demand and shifting the aggregate demand curve upward. However, according to (15), the rise in Λ_N shifts the aggregate supply curve inward. Our interpretation of this result is the following: labour-augmenting technical progress raises, via its effect on profits, aggregate demand and output thus increasing

the demand for labour but, simultaneously, the rise in Λ_N reduces the amount of labour that is necessary to produce the initial level of output, the net effect on employment being negative. Therefore, this suggests that labour-augmenting technical progress reduces N_E unless the rates of growth of physical capital, capital-augmenting technical progress and aggregate demand offset it.

Expressions (39), (40), (43) and (44) reflect the effect on N_E of changes in the parameters and arguments of the aggregate demand function. A rise in the propensity to consume by wage earners c_w or profit-recipients c_d increases N_E. A rise in the cost of capital to firms r and an improvement in profit expectations Ψ leads to a fall and a rise in N_E respectively. Finally, according to expressions (41) and (42), the effect on N_E of an increase in the nominal volume of fixed payments by firms resulting from outstanding debt F or an increase in the proportion of gross profits disbursed to profit recipients k have an ambiguous effect on N_E. In particular, the effect depends ultimately on the relative values of the different propensities to consume and invest. Interestingly, if the propensity to consume by rentiers is higher than the sum of the propensity to consume by profit recipients and the propensity to invest out of retained profits, a rise in F has an expansionary effect on N_E. Comparative statics analysis results for the price level are shown below.

$$\frac{dp}{dK} = \left(\frac{1}{B}\right)(1-\rho)\frac{p}{K}\cdot\left[T_3 + T_4\right] \gtreqless 0 \qquad (45)$$

where $T_3 = \dfrac{(1-\alpha)\left(\Lambda_K K\right)^{\rho}}{\Omega}\cdot(1-\rho-(c_w - c_p - I_p)\cdot(1/m)) \succ 0$ and

$$T_4 = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho} \cdot \left(\rho - (c_p + I_p) + (1-\rho)\cdot \frac{(1-\alpha)\left(\Lambda_K K\right)^{\rho}}{\Omega}\right) \prec 0$$

$$\frac{dp}{dw} = \left(\frac{1}{A}\right)\cdot\left[m + \left(\frac{\rho}{B}\right)\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho}\cdot J\right] \prec 1 \qquad (46)$$

where $J = \left[(c_w - m) + (m-1)(c_p + I_p)\right] \prec 0$

$$\frac{dp}{dm} = \left(\frac{1}{B}\right)\cdot pl\cdot\left[(c_w - c_p - I_p)(1/m^2) + (c_p + I_p - 1)(1/m)\right] \succ 0 \qquad (47)$$

since $\left|(c_w - c_p - I_p)\cdot 1/m\right| \prec \left|c_p + I_p - 1\right|$

$$\frac{dp}{d\,c_w} = \left(\frac{1}{BM}\right)\cdot w\cdot\left[-(1-\rho) + \frac{\alpha\left(\Lambda_N N\right)^{\rho}}{\Omega}\right] \succ 0 \quad \text{since} \quad \frac{\alpha\left(\Lambda_N N\right)^{\rho}}{\Omega} \prec 1 \qquad (48)$$

$$\frac{dp}{dk} = \left(\frac{-1}{B}\right)\cdot p(1-\rho)\cdot\Omega^{-1/\rho}\cdot(c_d - I_{gp})\left(\Omega^{1/\rho} - \frac{MN}{m} - \frac{F}{p}\right)\cdot\left(\frac{1-\alpha}{\alpha}\right)\cdot\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho} \underset{\geq}{\leq} 0 \qquad (49)$$

since $T_5 = c_d - I_{gp} \underset{\geq}{\leq} 0$

$$\frac{dp}{d\,\Lambda_K} = \left(\frac{1}{B}\right)\cdot p(1-\rho)\cdot\Lambda_K^{-1}\cdot\left(T_6 + T_7\right) \underset{\geq}{\leq} 0 \qquad (50)$$

since $T_6 = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho}\cdot\left((1-\rho)\cdot\frac{(1-\alpha)\left(\Lambda_K K\right)^{\rho}}{\Omega} - (c_p + I_p - \rho)\right) \underset{\geq}{\leq} 0$ and

$$T_7 = \left(\frac{(1-\alpha)\left(\Lambda_K K\right)^{\rho}}{\Omega}\right)(c_p + I_p)\cdot(2 + 1/m) - \rho - 1 - \frac{c_w}{m} \underset{\geq}{\leq} 0$$

$$\frac{dp}{d\,\Lambda_N} = \left(\frac{1}{B}\right)\cdot p\cdot\Lambda_N^{-1}\left[(1/m)T_8\cdot T_9 + (1-\rho)^2\frac{\alpha\left(\Lambda_N N\right)^{\rho}}{\Omega}\cdot\left(1 - \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho}\right) + T_{10}\right] \underset{\geq}{\leq} 0 \qquad (51)$$

since $T_8 = (c_w - c_p - I_p) \underset{\geq}{\leq} 0$, $T_9 = \rho\left(\frac{\alpha\left(\Lambda_N N\right)^{\rho}}{\Omega} - 1\right) - \frac{\alpha\left(\Lambda_N N\right)^{\rho}}{\Omega} \underset{\geq}{\leq} 0$ and

$T_{10} = 2\rho - \rho^2 - (c_p + I_p) \underset{\geq}{\leq} 0$

$$\frac{dp}{dF} = \left(\frac{1}{B}\right)\left[(1-\rho)(I_p + c_p - c_r)\,\Omega^{-1/\rho}\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho}\right] \underset{\geq}{\leq} 0 \qquad (52)$$

since $T_1 = I_p + c_p - c_r \underset{\geq}{\leq} 0$

$$\frac{dp}{d\,c_d} = \left(\frac{-1}{BM}\right)\cdot(1-\rho)\cdot p\cdot k\cdot\Omega^{-1/\rho}\cdot\frac{(1-\alpha)\left(\Lambda_K K\right)^{\rho}}{\Omega}\left(y - \frac{MN}{m} - \frac{F}{p}\right) \succ 0 \quad (53)$$

since aggregate gross profits in real terms $= \left(y - \frac{MN}{m} - \frac{F}{p}\right) \succ 0$.

$$\frac{dp}{dr} = \left(\frac{-1}{B}\right)\cdot\left[(1-\rho)\,\Omega^{-1/\rho}\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho}\cdot I_r\right] \prec 0 \text{ since } I_r \prec 0 \quad (54)$$

$$\frac{dp}{d\Psi} = \left(\frac{-1}{B}\right)\cdot\left[(1-\rho)\,\Omega^{-1/\rho}\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho}\cdot I_\Psi\right] \succ 0 \text{ since } I_\Psi \succ 0 \quad (55)$$

These results are more ambiguous than results for the level of employment. As before, table 1 summarizes the results for the price level and, in addition, it shows the effect on the real wage of a variation in any of the exogenous variables. A rise in the average degree of monopoly m, the propensity to consume by wage earners c_w and profit recipients c_d and an improvement in profit expectations Ψ pushes up the price level and pushes down the real wage, whereas a rise in the cost of capital r has just the opposite effect. With the exception of the effect of a variation in the money wage rate, the effect on the price level and the real wage of variations in any of the remaining

exogenous variables and parameters is ambiguous. As for the effect on the price level of a variation in the money wage rate w, we know from (35) that a rise in w reduces N_E. Then, expressions (56) and (57) below - where (57) is the result of re-arranging (9) - show that a fall in the level of employment raises the marginal productivity of labour M and this, in turn, raises the real wage.

$$\frac{\partial M}{\partial N} = (1-\rho)\,\Omega^{1/\rho-1}\cdot\alpha\left(\Lambda_N N\right)^{\rho}\cdot N^{-2}\left(\frac{\alpha\left(\Lambda_N N\right)^{\rho}}{\Omega}-1\right)\prec 0 \qquad (56)$$

$$\frac{w}{p}=\frac{M}{m} \qquad (57)$$

Therefore, we have that a rise in the money wage rate pushes up the real wage i.e. that $dp/dw \prec 1$, this being compatible, in turn, with either a fall or a rise in the price level as long as the latter rises less than w. Expression (46) above shows that this is the case because $J \prec 0$ and the inverse of the average product of labour A is well below unity. Therefore, a rise in the money wage rate is coupled with a rise in the real wage and vice-versa. What is more intriguing is the fact that, since $J \prec 0$, a rise in the money wage rate w may end up lowering the price level and vice-versa. The reason for this 'paradox of cost' is that, although a rise in w initially raises marginal costs, the latter will fall subsequently as a result of the rise in the marginal product of labour brought about by the reduction in the level of employment[13]. The final impact on the price level thus depends on the behaviour of marginal costs of firms which may raise or fall depending on: (i) the size of the reduction in employment brought about by the rise in w and (ii) the rise in the marginal product of labour M brought about by the reduction in employment. Looking at (46) and J above, it can be seen that it is rather unlikely that dp/dw be negative. However, it cannot be ruled out beforehand. We will return to this issue below.

	dK	dw	dw^b	dm	$d\Lambda_K$	$d\Lambda_N$	dc_w	dc_d	dk	dr	$d\psi$	dF
dN	+	-	?	-	+	-	+	+	?	-	+	?
dp	?	?	?	+	?	?	+	+	?	-	+	?
$d(w/p)$	?	+	?	-	?	?	-	-	?	+	-	?

Table 1: Summary of comparative statics analysis

3.4.- Labour market dynamics in the 'basic' AS-AD model

As shown above, money wage rate variations lead to variations of the real wage in the same direction. In turn, the inverse relation between the real wage and the level of employment that results from (56) and (57) indicates that the aggregate demand for labour curve in real wage-employment space is downward-sloping as shown in figure 2 below, although this arises from the assumption of a diminishing marginal product of labour. Thus, the negative slope of the aggregate demand for labour curve is determined exclusively by the technology available to firms – since the mark-up is assumed to be constant – so that aggregate demand does not play any role in the determination of the *size* of its slope.

Of more substance in the 'basic' model is the fact that money wage flexibility eventually pushes the economy to its full employment equilibrium where the aggregate supply and demand for labour intersect[14] in real wage-employment space. A crucial implication of this result is that, as long as the money wage rate is not rigid, the long-run level of output is determined in the labour market or, equivalently, it is supply-side determined. For instance, in figure 2 below, if the real wage is $(w/p)_1$, then the aggregate supply of labour exceeds the aggregate demand for labour and the money wage rate tends to fall. As this occurs, the level of employment N_E in figure 3 below increases, as emerged from (35). This process continues as long as the real wage is above $(w/p)_{FE}$. Likewise, if the real wage is $(w/p)_2$, the aggregate demand for labour exceeds the aggregate labour supply and the money wage rises thus reducing N_E[15]. Therefore, the

implications of the 'basic' AS-AD model are in conformity with Classical theory, i.e. unemployment is caused by real wages that are 'too' high and the way to cure it is to cut money wages[16].

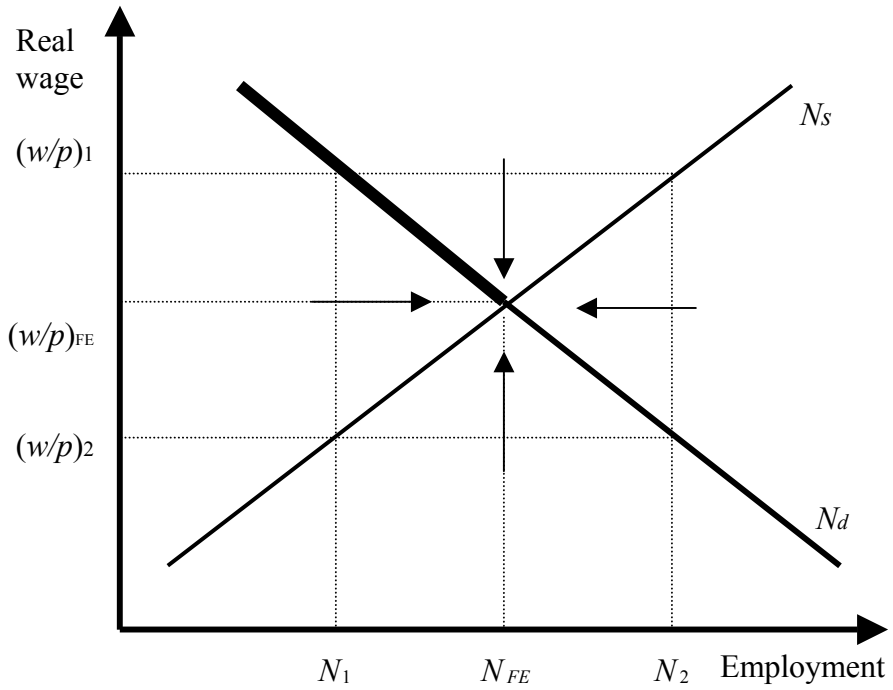

Figure 2: The Classical labour market (stable equilibrium)

In addition, the level of full employment N_{FE} is stable as the arrows in figure 2 indicate. One important caveat to the above story arises from the possibility that (46) be negative so that a fall in the money wage rate leads to a rise in the price level. If this was the case, the adjustment process described above could be offset by a rise in interest rates induced by the central bank or, if the latter targets money supply, by the operation of the real balance effect. Alternatively, if (46) is positive, the process of convergence toward full employment equilibrium will be reinforced for the very opposite reason. Therefore, even in the 'basic' AS-AD model, the convergence toward full employment may come across some obstacles. However, although the diagnose of unemployment that emerges from the 'basic' AS-AD model is along the lines of Classical theory, the mechanics of how the economy returns to full employment after a shock are different.

Let us consider how aggregate demand adjusts to a falling money wage rate in the context of the neoclassical synthesis. Within that framework falling money wages and prices lead overtime to an increase in aggregate demand if the *wealth* effect that results from the falling price level is stronger than the *substitution* effect that arises from a falling rate of growth of prices. The operation of the *wealth* effect is as follows. For a given level of aggregate demand, the falling price level leads, insofar as the central bank keeps the rate of growth of the money stock constant, to a rise in real money balances which, in turn, increases aggregate spending both *directly*, as the rise in real money balances expands the real financial wealth of households and leads to an increased demand for commodities (the Pigou effect) and *indirectly*, as the rising real money balances reduces the supply of bonds by firms and increases the demand for bonds by households respectively thereby leading to a fall in the real interest rate and a rise in investment demand (the Keynes effect). As for the operation of the *substitution* effect, a falling rate of growth of the price level makes both money and bonds relatively more attractive to hold than commodities and, thus, it reduces aggregate demand (Patinkin, 1965, pp. 359-65). As a result, the Classical position is rationalized by assuming that the aggregate demand for commodities is sufficiently sensitive to the stimulating effects of the interest and price changes generated by falling money wages.

It is not our purpose here to provide an extensive discussion of the problems encountered by the adjustment mechanism described above (see Palacio-Vera, 2002). In any case, we wish to make two considerations. First, modern central banks do not target money supply but, rather, they set interest rates with a view to targeting variables such as inflation and output, so that money supply is determined endogenously. As a result, the money stock is highly correlated with the price level so that its value in real terms is hardly affected by price level variations (Moore, 1988, ch. 12; Graziani, 1990). Second,

if the central bank sets short-term interest rates so that they are lowered when inflation falls and vice-versa, we wonder whether the implementation of this simple monetary policy rule will actually push the economy towards full employment. This is because, even assuming that aggregate demand is sufficiently interest-elastic, central banks can *only* spur aggregate demand as long as nominal interest rates remain above its zero lower bound. Once the latter is reached, central bank are not able to stimulate aggregate spending any further. Indeed, if money wages and prices keep falling once nominal interest rates have hit the zero lower bound, real interest rates will rise rather than fall.

By contrast, the AS-AD model presented above does not rely on the existence of a powerful real balance effect or the ability of the central bank to manage interest rates skilfully and, in this sense, we believe it provides a more consistent story of the process of adjustment of the economy in the long run. In particular, the adjustment of aggregate demand to aggregate supply in the long run in the AS-AD model displayed above does *not* depend on the assumption that the former is sufficiently sensitive to the stimulating effects of the interest and price changes generated by a falling money wage rate. Let us see how this process occurs. If, as before, the real wage is $(w/p)_1$ in figure 2 and the equilibrium level of employment is N_E^1 in figure 3 below (corresponding to point E_1) then, as the money wage rate falls[17], the Z-curve shifts outward from $Z_1(N)$ to $Z_2(N)$ and the D-curve shifts downward[18] from $D_1(N)$ to $D_2(N)$ so that the new equilibrium becomes E_2. Next, we have that, for the level of employment N_E^1, the total revenue of firms $D_2(N^1)$ now exceeds $Z_2(N^1)$, i.e. the total costs incurred by firms to produce y_1. Thus, firms realize that they can raise profits by increasing production and hiring additional workers. However, as employment rises, aggregate demand also increases (see expression (24) above) so that, as long as $D(N)-Z(N)\succ 0$, firms keep revising sales expectations and production plans upward. Thus, the equilibrium level of employment

gradually increases from N_E^1 to N_E^2 in figure 3. In the meantime, as long as $N_E \prec N_{FE}$ the money wage rate keeps falling and the *Z* and *D* curves continue to shift outward and downward respectively. This process only ceases when $N_E = N_{FE}$ and the real wage is $(w/p)_{FE}$, at which point the money wage rate stops falling and firms´ sales expectations are just realized. Thus, a simple process of revision of short-run sales expectations by profit-maximising firms in the wake of changes in actual sales and revenue drives the economy to its full employment equilibrium[19].

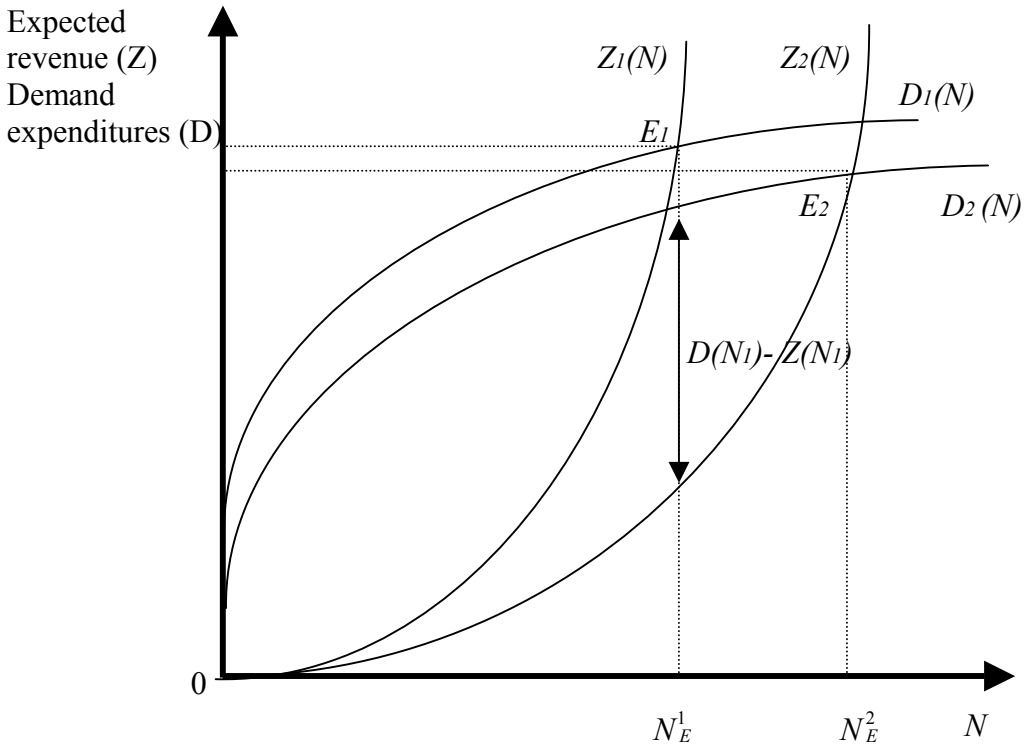

Figure 3: The adjustment mechanism to a falling money wage rate in the 'basic' AS-AD model

4.- The 'extended' AS-AD model

The 'basic' AS-AD model displayed above leads to a relatively optimistic view of the self-stabilizing properties of market economies. However, these properties rely heavily on the notion that money wage rate reductions and the resulting fall in the price

level (if it actually falls) do not affect adversely aggregate demand as a result, for instance, of changes in income distribution, increases in the debt burden of firms or diminished profit expectations. Indeed, starting with Fisher (1933) and Keynes (1936, ch.19), an extensive list of authors has pointed to a number of problems and dangers posed by a deflationary process. Contributions to this line of reasoning can be found, for instance, in Kalecki (1944), Tobin (1975), Minsky (1975), Chick (1983, ch.7), DeLong and Summers (1986), Hahn and Solow (1986), Howitt (1986), Caskey and Fazzari (1987), Palley (1996, ch.4), Flaschel and Franke (2000) and Sawyer (2001). Again, it is not our purpose to review this literature[20]. Rather, we aim at exploring the implications of dropping one of the assumptions in the 'basic' model. In particular, in what we call the 'extended' AS-AD model, we let the ratio of the debt service of firms to nominal output f change as the price level varies and, in addition, we assume that changes in f affect firms´ willingness to invest as well as their ability to raise external funds. Indeed, the adverse effect of a falling price level on aggregate demand due to a rising debt burden of firms and the resulting negative effect on investment arising from some firms becoming insolvent is one of the factors[21] identified by Keynes (1936, p. 268) in the *General Theory* as making wage flexibility undesirable[22]. Let us assume that a rise in the ratio of the debt service of firms to nominal output f leads to higher creditor and debtor risk. Since we assumed above that firms are net debtors, this implies that they finance investment, at least partly, from external sources.

Creditor and debtor risk rise because financial margins of safety decline and bankruptcy becomes more likely as f rises. In turn, this may reduce the net spending of debtors and creditors for, at least, the two following reasons (Caskey and Fazzari, 1987). First, as debtors approach technical insolvency, they reduce spending by *more* than what one would expect as a result of falling net worth due to bankruptcy costs.

These bankruptcy costs include the difficulties that borrowers with a history of debt repayment problems will have when trying to obtain credit or the costs of explicit bankruptcy and foreclosure resulting from the loss of ownership rights that may again be valuable in the future. Thus, debtors (firms) have an interest in avoiding bankruptcy so they will attempt to remain solvent by cutting (investment) expenditure when there is an unanticipated rise in the real value of their nominal debt obligations (see Bernanke, 1981). Second, bankruptcy costs represent a *net* wealth loss to creditors (households) since they prevent creditors´ wealth from increasing as much as borrowers´ wealth declines following an unanticipated fall in the price level. This may be the case because (i) bankruptcy and foreclosure can result in significant legal costs, (ii) assets obtained through foreclosure may be out of service for some time while bankruptcy proceedings are carried out, and (iii) if the creditor turns out to be a financial intermediary, it is likely to be ill-equipped to use the assets acquired through foreclosure and this, in turn, may force it into sales of these assets at a time when 'distress' sales are widespread and, consequently, market prices are low (see Caskey and Fazzari, 1987). These arguments suggest that collateral is worth less to creditors than to debtors so that bankruptcy imposes net social costs and, in turn, they justify the presence of f as an argument in the investment function to be added to the effect on investment of the flow of gross profits R.

4.1.- Comparative statics in the 'extended' AS-AD model

The 'extended' AS-AD model retains all the features and equations of the AS-AD 'basic' model displayed in section 3 except the investment function (22) which now includes the ratio of the debt service of firms to nominal aggregate output f as an additional argument so that we have

$$I^b = ((1-k)R; r; \psi; f) \qquad I_f \prec 0 \qquad (58)$$

and

$$f = \frac{F}{py} = 1 - WS - \left(\frac{R}{py}\right) \qquad (59)$$

where the superscript b denotes the expressions of the 'extended' AS-AD model. As a result, the *E* equation becomes

$$E^b = c_w wN + c_p R + (c_r - c_p)F + I((1-k)R; r; \psi; f) - mwN - \left(\frac{1-\alpha}{\alpha}\right)mwN\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho} \qquad (60)$$

and

$$\frac{dN}{d\,w^b} = \left(\frac{1}{B^b}\right)\cdot\left(\frac{N}{p}\right)\cdot H^b \gtreqless 0 \qquad (61)$$

and let us assume that

$$B^b = \left[(T_8)(1/m) - T_{11}\cdot\left(1 + (1-\rho)\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho}\right)\right] \prec 0$$

$$H^b = \left[(-T_8) + m(T_{11})\cdot\left(1 + \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_K K}{\Lambda_N N}\right)^{\rho}\right)\right] \gtreqless 0$$

so that $T_8 = (c_w - c_p - I_p) \gtreqless 0$ and, by assumption, $T_{11} = 1 - c_p - I_p + I_f \cdot \frac{f}{py} \succ 0$.

Our interest is in the effect on the level of employment and the price level of variations in the money wage rate. It is clear from (61) that the effect of a money wage rate change on the equilibrium level of employment N_E can have any possible sign since B^b and H^b can be positive, negative or zero[23]. However, if $B^b \succ 0$, the 'extended' model will yield unrealistic predictions since, for instance, a rise in the cost of capital r will raise the level of employment and an improvement in profit expectations Ψ will lower it. Thus, let us assume that $B^b \prec 0$. In turn, this implies that $T_{11} \succ 0$. Next, we address the sign of H^b. Since $T_{11} \succ 0$, we have that, if $T_8 \succ 0$, H^b can take on any sign

thereby making (62), in turn, take on any sign as well. In particular, if c_w takes a much larger value than $c_p + I_p$, and $|\rho|$ is well in excess of unity, it is even possible that $B^b \prec 0$ and $H^b \leq 0$ so that $dN/dw^b \geq 0$. This suggests that, when we incorporate into the model the adverse effects on investment brought about by changes in the debt service of firms relative to nominal output, it is not necessarily the case that money wage cuts lead to a rise in the level of employment and they may even reduce it. These results lend support for Keynes´ theory of involuntary unemployment equilibrium and for his scepticism regarding the possibility of removing it through cuts in the money wage rate. The implications for labour market dynamics are discussed below. Finally, as in the 'basic' AS-AD model, the effect of variations in the money wage rate on the price level is also ambiguous since:

$$\frac{dp}{dw^b} = \left(\frac{1}{A}\right) \cdot \left[m + \left(\frac{\rho}{B^b}\right)\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\Lambda_k K}{\Lambda_N N}\right)^{\rho} \cdot J^b \right] \begin{matrix} \leq \\ = \\ \geq \end{matrix} 0 \qquad (62)$$

where $J^b = \left[(c_w - m) + (m-1)(c_p + I_p) - m\left(\frac{I_f \cdot f}{p \cdot \Omega^{1/\rho}}\right) \right] \begin{matrix} \leq \\ = \\ \geq \end{matrix} 0$.

The ambiguity of (62) can be rationalized along the same terms as in section 3.3 above. The sign of J^b in (62) is the key to know the impact on the price level of money wage rate variations. First, since the slope of the aggregate demand for labour curve is necessarily negative (for the reasons given above) we have that, even if $B^b \prec 0$ and $J^b \succ 0$, so that (62) is positive, we still have that $dp/dw^b \prec 1$. But, if $J^b \prec 0$, then (62) may become negative. As explained above, the occurrence of this 'paradox of costs' affects crucially labour market dynamics. However, as long as $f \succ 0$ and $I_f \prec 0$, we

have that $J^b \succ J$ and, as a result, it is less likely that a 'paradox of cost' arises in the 'extended' AS-AD model than in the 'basic' one. Needless to say, if it turns out that (62) is negative, the possible adverse (favourable) effect of a cut in the money wage rate on the level of employment will be reinforced (partly offset) by interest rate rises induced by the central bank or the operation of the real balance effect as prices go up. In any case, we adopt the scenario characterised by the non-occurrence of a 'paradox of costs' as the likeliest one and we focus on the particular case in which a fall in the money wage rate leads to a fall in the level of employment.

4.2.- Labour market dynamics in the 'extended' AS-AD model when the money wage rate and the level of employment move in opposite directions

When expression (62) is positive, a cut in the money wage rate reduces – subject to the possible offsetting effect brought about by a falling price level - the equilibrium level of employment N_E. As we show in figures 4 and 5 below, in this particular case, the level of full employment N_{FE} becomes *unstable*. For instance, if the initial real wage and level of employment are $(w/p)_1$ and N_1 respectively in figure 4, the supply of labour exceeds the demand for labour and, as a result, the money wage rate tends to fall. However, as we show in figure 5, as this occurs, the economy moves from point E_1 to point E_2 and the equilibrium level of employment N_E falls from N_E^1 to N_E^2. In the labour market depicted in figure 4 below, as the money wage rate falls, the level of employment also falls thereby pushing it further away from the long-run equilibrium level of employment N_{FE}. The opposite result comes about if the real wage and level of employment are $(w/p)_2$ and N_2 respectively. Even if expression (62) is negative so that a fall in the money wage rate leads to a higher level of employment, the possible occurrence of a 'paradox of costs' may prevent the economy from converging to N_{FE}.

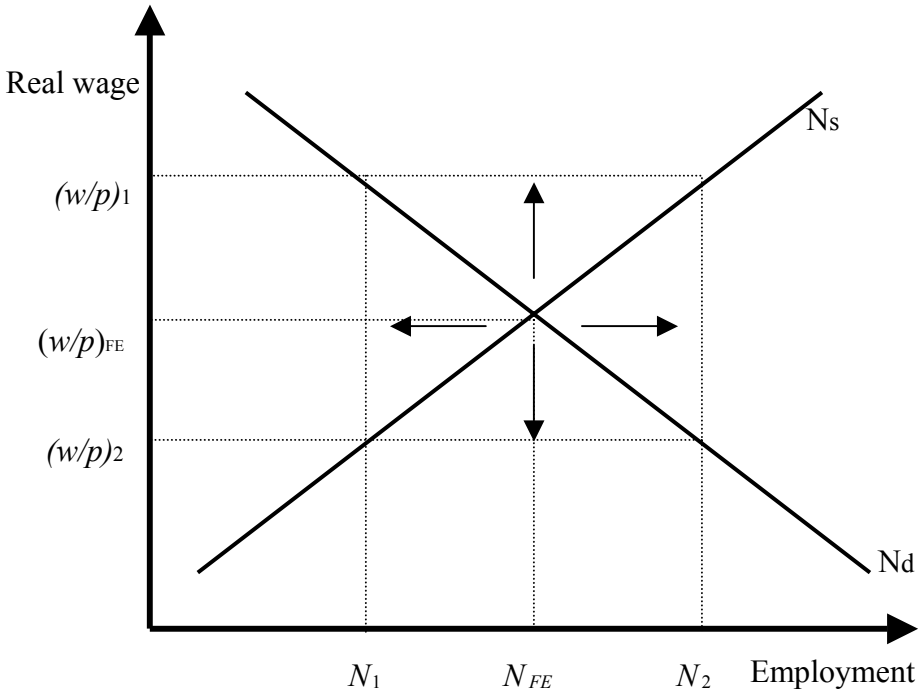

Figure 4: Unstable long-run equilibrium level of employment

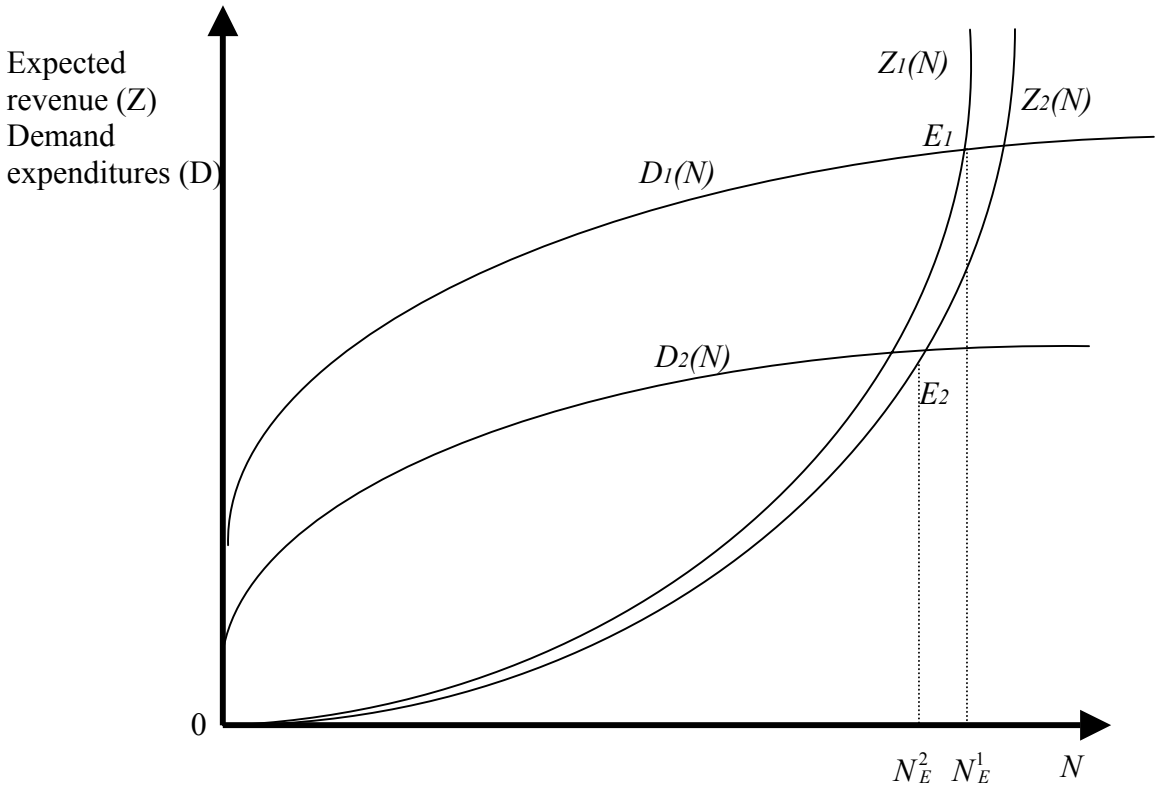

Figure 5: The adjustment mechanism to falling money wages in the 'extended' AS-AD model when the money wage rate and employment co-move

This analysis highlights the fact that cuts in the money wage rate may not necessarily cure unemployment and, instead, it may aggravate it. It also suggests that N_{FE} may not be an attractor and that, as a result, the long-run level of economic activity may be demand-determined rather than supply-determined. In particular, if N_{FE} turns out to be unstable, then the long-run equilibrium level of employment cannot be ascertained by resort to labour supply and demand analysis. In that case, we have a continuum of equilibria rather than a 'definite determinate' equilibrium (Kaldor, 1934).

6.- Conclusion

This paper has sought to address the effects on employment of a range of factors including capital accumulation, technical progress and money wage rate changes by building on the AS-AD framework posited by Keynes in the *General Theory* and elaborated by Weintraub and Chick. This was done by inserting a constant elasticity of substitution (CES) production function in the model and performing a full comparative statics analysis. Among other results, we found that capital accumulation and capital-augmenting technical progress lead to higher employment whereas labour-augmenting technical progress and a higher degree of market power lead to lower employment. In general, the effects of changes in the money wage rate on the level of employment and the price level were found to be ambiguous, especially when due account is taken of the effect on the debt burden of firms in real terms of changes in the price level. Finally, we have argued that Keynes´ approach to AS-AD analysis provides a more consistent framework than conventional AS-AD analysis does because, among other reasons, the adjustment of aggregate demand to aggregate supply in the long run (for instance, in the face of falling money wages) does not depend on the assumption that aggregate demand

is sufficiently sensitive to the stimulating effects of the interest and price changes generated by falling prices.

Appendix

According to the general theorem of the existence of implicitly expressed vector fields, we can obtain the following system of equations in matrix form

$$\begin{pmatrix} \frac{dE}{dN} & \frac{dE}{dp} \\ \frac{dPL}{dN} & \frac{dPL}{dp} \end{pmatrix} \begin{pmatrix} dN \\ dp \end{pmatrix} + \begin{pmatrix} \frac{dE}{dK} & \frac{dE}{d\Lambda_K} & \frac{dE}{d\Lambda_N} & \cdots & \frac{dE}{dr} & \frac{dE}{d\Psi} & \frac{dE}{dF} \\ \frac{dPL}{dK} & \frac{dPL}{d\Lambda_K} & \frac{dPL}{d\Lambda_N} & \cdots & \frac{dPL}{dr} & \frac{dPL}{d\Psi} & \frac{dPL}{dF} \end{pmatrix} \begin{pmatrix} \\ \bar{b} \\ \\ \end{pmatrix} = 0 \quad (63)$$

or $$A_{2x2} \cdot \begin{pmatrix} dN \\ dp \end{pmatrix} + C_{2x11} \cdot \bar{b} = 0 \quad (64)$$

where $\bar{b}^t = (dK \;\; d\Lambda_K \;\; d\Lambda_N \;\; dw \;\; dm \;\; dc_w \;\; dc_d \;\; dk \;\; dr \;\; d\Psi \;\; dF)$, N and p are the endogenous (or basic) variables and the remaining ones are exogenous (non-basic). Re-arranging (64) and multiplying it through by vector $(1/\bar{b})^t$, we get

$$\begin{pmatrix} \frac{dN}{dK} & \frac{dN}{d\Lambda_K} & \frac{dN}{d\Lambda_N} & \cdots & \frac{dN}{dr} & \frac{dN}{d\Psi} & \frac{dN}{dF} \\ \frac{dp}{dK} & \frac{dp}{d\Lambda_K} & \frac{dp}{d\Lambda_N} & \cdots & \frac{dp}{dr} & \frac{dp}{d\Psi} & \frac{dp}{dF} \end{pmatrix} = A_{2x2}^{-1} \cdot - C_{2x11} \cdot I \quad (65)$$

where I is the identity matrix,

$$A_{2x2}^{-1} = \begin{pmatrix} a_{11}^{-1} & a_{12}^{-1} \\ a_{21}^{-1} & a_{22}^{-1} \end{pmatrix} = \frac{1}{|A|} \cdot \begin{pmatrix} a_{22} & -a_{12} \\ -a_{21} & a_{11} \end{pmatrix} \quad \text{and} \quad |A| = p \cdot M \cdot B \,.$$

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[1] The main criticisms thrown upon conventional AS-AD analysis are (Dutt, 2002, pp.326-28): (i) that it is internally inconsistent because it contains two very different theories of production and pricing, (ii) that it fails to portray Keynes´s theory of output and employment adequately since the model implies that wage flexibility necessarily leads to full employment and that short-run unemployment is due to wage rigidity and (iii) that it leads to a conflation of macro- and microeconomic concepts since some expositions give the mistaken impression that the aggregate demand curve is similar to the micro demand schedule. As Dutt (2002, p. 329) remarks, Keynes´s theory does not suffer from these problems.

[2] Additional contributions are those by Dillard (1948), Wells (1960), Marty (1961), Kregel (1976), McCombie (1985/86) and Vickers (1987). A recent overview of the approach can be found in King (1994).

[3] See Chick (1983, ch. 5) for a detailed analysis of the micro-foundations of the aggregate supply function under different market forms.

[4] Thus the aggregate level of output becomes a Hicksian composite commodity.

[5] We show below why the intercept of the aggregate demand function is likely to be positive.

[6] As Chick (1983, p. 63) insists, the *Principle of Effective Demand* is the generalisation of the common microeconomic proposition that 'firms choose to produce whatever volume of output they believe will maximise their profits, given their cost estimate and demand forecasts'.

[7] Therefore, the price level is a mark-up *m* of the efficiency money wage rate *w/M* (Vickers, 1987, p. 91).

[8] As Vickers (1987) shows, a *linear* aggregate supply function is consistent with diminishing marginal productivity of labour and, therefore, it is wrong, as Weintraub (1957, p. 459; 1958, p.30) does, to assume that the presence of diminishing marginal productivity of labour is sufficient to guarantee convexity of the aggregate supply curve.

[9] Profit recipients include shareholders receiving dividends.

[10] For the sake of simplicity we avoid any further differentiation between net debtors and net creditors within the household sector.

[11] We have opted for a general formulation of the investment function in which, in principle, investment varies with the current level of economic activity because investment is, at least partly, financed out of current profits and profits vary positively with the current level of activity. As Chick (1983, p. 67) recognizes, 'Keynes´s view is that investment is chiefly sensitive to *future* expected demand and to current interest rates'. If investment is not a function of the current level of economic activity then we have $I_p = 0$ so that the former is determined exclusively by interest rates and (exogenous) long-term expectations. Our formulation can be seen as an attempt to reconcile the positions by Keynes and Kalecki on the determinants of investment (see, for instance, López and Mott, 1999).

[12] A similar result, though subject to several qualifications, is obtained in Davidson and Smolensky (1964, pp. 165-66). However, in that work, the negative effect on employment of a rise in the money wage rate is the result of a redistribution of income from rentiers to profit recipients where $c_p \prec c_r$.

[13] In particular, the occurrence of the 'paradox of cost' is more likely the higher is the absolute value of ρ relative to the value of *B*.

[14] We assume that the aggregate labour supply curve slopes upward.

[15] Indeed, if one assumes that money wages are bid up quickly to the full extent necessary to satisfy the demand for labour, points below the market-clearing wage are not observed except temporarily so that, for a given physical capital stock and technology, the potential positions of observed employment are those depicted by the bold line in figure 2 truncated at $(w/p)_{FE}$.

[16] In modern economic analysis, this idea can be traced back to Modigliani (1944). A recent contribution along these lines is that by Driskill and Sheffrin (1986). However, an essential insight of Keynes´ *General Theory* (Keynes, 1936, ch. 19) is that cuts in the money wage rate do not lead to higher employment and output.

[17] See expression (16) above.

[18] Although the sign of (28) is ambiguous, we assume for presentational purposes that the aggregate demand curve shifts downward – but less than the aggregate supply curve - when the money wage falls and vice-versa.

[19] This adjustment process can be seen as part of what Kregel (1976) calls the 'Model of Stationary Equilibrium' put forward by Keynes (1936) in the *General Theory* rather than as part of the 'Model of Static Equilibrium' referred to above.

[20] See Chick (1983, ch.7) and Dutt (1986/87) for a general discussion on the arguments against increased wage flexibility.

[21] Keynes (1936, ch.19) suggests that falling wages can lead to lower aggregate demand as a result of: (i) lower consumption demand due to income redistribution from workers and firms to rentiers, (ii) more pessimism among entrepreneurs due to workers´ discontent, (iii) a higher debt burden of firms leading to lower investment, (iv) lower investment and a lower propensity to consume due to expectations of further reductions in money wages and (v) increased uncertainty in business decision-making caused by price instability.

[22] As Chick (1983, p. 132) points out 'the proposition that wages are "sticky" – that is, loath to move although perfectly free to do so – is not an assumption but a *prediction* of Keynes´s theory'.

[23] This result is also reflected in table 1 above.